

AD-A283 501



(Unclassified Paper)

NAVAL WAR COLLEGE  
Newport, RI

NOT SO FRIENDLY FIRE:  
CONSIDERATIONS FOR REDUCING THE RISK OF FRATRICIDE

by

GARY J. BUNDY  
Colonel, U.S. Air Force



A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

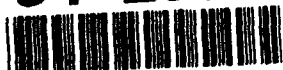
Signature: G. Bundy

18 June 1994

Paper directed by Captain D. Watson, U.S. Navy  
Chairman, Operations Department

DTIC QUALITY INSPECTED 1

33P 94-25906



94 8 16 08 2

## REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION <b>Unclassified</b>		1b. RESTRICTIVE MARKINGS	
1. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT <b>DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.</b>	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		7a. NAME OF MONITORING ORGANIZATION	
6a. NAME OF PERFORMING ORGANIZATION <b>OPERATIONS DEPARTMENT</b>	6b. OFFICE SYMBOL (If applicable) <b>C</b>	7b. ADDRESS (City, State, and ZIP Code)	
6c. ADDRESS (City, State, and ZIP Code) <b>NAVAL WAR COLLEGE NEWPORT, R.I. 02841</b>		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	10. SOURCE OF FUNDING NUMBERS	
8c. ADDRESS (City, State, and ZIP Code)	PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO. WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) <b>Not So Friendly Fire: Considerations For Reducing The Risk of Fratricide - Unclass</b>			
12. PERSONAL AUTHOR(S) <b>Colonel Gary J. Bundy, U.S. Air Force</b>			
a. TYPE OF REPORT <b>FINAL</b>	13b. TIME COVERED FROM TO	14. DATE OF REPORT (Year, Month, Day) <b>18 June 1994</b>	15. PAGE COUNT <b>32</b>
16. SUPPLEMENTARY NOTATION <b>A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.</b>			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
<p style="text-align: center;">Abstract of</p> <p style="text-align: center;"><b><u>NOT SO FRIENDLY FIRE:</u></b></p> <p style="text-align: center;"><b><u>CONSIDERATIONS FOR REDUCING THE RISK OF FRATRICIDE</u></b></p> <p>All commanders expect losses in combat, but when the casualties are self-inflicted the effects are magnified. The Gulf War brought the fratricide problem into sharp focus based on a disturbing increase in the percentage of losses due to friendly fire. Much of the recommended corrective action has been directed towards technological solutions. While this approach does provide some fratricide protection, a review of history and the causes of fratricide indicates more needs to be done. This paper explores the background of fratricide, its underlying causes and contends that only a combined application of doctrine, training and technology is likely to minimize the risk of future fratricide.</p>			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION <b>Unclassified</b>	
a. NAME OF RESPONSIBLE INDIVIDUAL <b>CHAIRMAN, OPERATIONS DEPARTMENT</b>		22b. TELEPHONE (Include Area Code) <b>841-3414</b>	22c. OFFICE SYMBOL <b>C</b>

Abstract of

NOT SO FRIENDLY FIRE:

CONSIDERATIONS FOR REDUCING THE RISK OF FRATRICIDE

All commanders expect losses in combat, but when the casualties are self-inflicted the effects are magnified. The Gulf War brought the fratricide problem into sharp focus based on a disturbing increase in the percentage of losses due to friendly fire. Much of the recommended corrective action has been directed towards technological solutions. While this approach does provide some fratricide protection, a review of history and the causes of fratricide indicates more needs to be done. This paper explores the background of fratricide, its underlying causes and contends that only a combined application of doctrine, training and technology is likely to minimize the risk of future fratricide.

Accession For	
NTIS	CRA&I
DTIC	TAB
Unannounced	<input type="checkbox"/>
Justification _____	
By _____	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

## TABLE OF CONTENTS

CHAPTER	PAGE
ABSTRACT . . . . .	ii
I INTRODUCTION . . . . .	1
II DEFINITIONS AND BACKGROUND . . . . .	4
III IMPACT . . . . .	8
IV CAUSES AND CONTRIBUTING FACTORS . . . . .	11
V WORKING THE PROBLEM . . . . .	15
Technology . . . . .	15
Doctrine . . . . .	18
Training . . . . .	20
VI CONCLUSIONS . . . . .	23
NOTES . . . . .	25
BIBLIOGRAPHY . . . . .	28

CHAPTER I  
INTRODUCTION

"The death of a soldier is always tragic, but never more so than when he is mistakenly cut down by his own comrades."<sup>1</sup>

The confusion is understandable. In every leg of the Clausewitzian triangle the question is the same. How could the same hi-tech fighting force that, during Desert Storm, plucked enemy missiles out of the sky and sent precision guided bombs down the Iraqi Air Ministry's ventilation shaft also be capable of inflicting such carnage on its own troops?<sup>2</sup> The answer, of course, is as complex as modern warfare itself.

Fratricide, or friendly fire as it is more commonly known, is perhaps the worst experience a combat unit can suffer and poses a significant challenge to the operational commander. The impact of fratricide goes far beyond the arithmetic of personnel and equipment losses. And, as demonstrated in the Gulf War, the problem may be getting worse, not better.

Certainly the problem is not new. In each of this country's wars friendly fire has resulted in a considerable number of troops being killed or wounded. When looking at World War I through Vietnam most studies place our losses from

fratricide at around two percent.<sup>3</sup> However, in Desert Storm the fratricide casualty rate was 10 times as high. Again the question why? More importantly, what are the fratricide implications for the future?

Many now believe that the characteristics of modern warfare, as demonstrated in the Gulf War, may be increasing the risk of fratricide. They argue that improvements in range, accuracy and lethality of modern weapons combined with warfare which emphasizes fast moving, deep penetrating, night operations have raised, not only the likelihood of fratricide, but also the seriousness of its consequences.

As seems to be our nature, many see the increased fratricide risk as a technological problem which can be solved mostly with technology. However, I contend the evidence does not support this view.

Few believe that fratricide will ever be completely eliminated. At best, we can only work to limit its occurrence and/or minimize the effects. It is unlikely that technology alone will do it. The purpose of this paper is to argue that only through a combination of improvements in doctrine and training supplemented by technological advances can the operational commander effectively manage the fratricide risk.

This paper will focus on the fratricide issue by first looking at the historical context with emphasis on the Gulf War. Then we will move to an examination of fratricide's impact on combat operations. Next will follow a review of the causes of friendly fire including several contributory factors. Finally, this paper will address the tools available to manage the risk of fratricide and will end with conclusions.

## CHAPTER II

### DEFINITIONS AND BACKGROUND

As always, it is best to start by defining the problem. The Army defines fratricide as:

"The unintentional killing or wounding of friendly personnel by fire."

For the purposes of this paper the incidents of fratricide are divided into four main types: air-to-surface, surface-to-surface, surface-to-air, and air-to-air. One can certainly find a more detailed breakdown, but I've chosen to restrict the discussion to these broad categories.

The first category, air-to-surface fratricide, relates to incidents in which friendly aircraft employ weapons against friendly surface forces, ground or sea. The second main type, surface-to-surface, involves friendly surface forces firing upon other friendly surface forces, again either ground or sea. This type includes friendly fires such as artillery, armor, mortar, ship-guided missile systems, etc. The next category, surface-to-air fratricide, deals essentially with friendly fire from surface forces against friendly aircraft. Last is the



air-to-air type of fratricide which involves friendly aircraft fires on other friendly aircraft.

As discussed in the introduction, most experts agree on two percent as the approximate estimate of fratricide casualties when looking at World Wars I, II, Korea and Vietnam. However, the author of the most detailed study on the issue, Dr. Charles R. Shrader, cautions that as a result of inadequate data no one really knows the magnitude of the problem in earlier warfare. Understandably, fratricide was not highlighted in records or reports and commanders were reluctant to report such incidents in the interest of the victims, their families, and unit morale.<sup>5</sup> However, the Shrader study does give one a good idea of the general fratricide causes and trends.

In the four wars mentioned, the first fratricide category, air-to-surface, accounted for the largest number of incidents and casualties.<sup>6</sup> A close second was surface-to-surface fratricide and a distant third was surface-to-air. Air-to-air incidents historically were deemed statistically insignificant.<sup>7</sup> While seemingly small, two percent when viewed against the total number of casualties in these wars represents a significant loss. As an example, it is estimated that 15,480

Americans, the equivalent of a full infantry division, were lost to fratricide in World War II.<sup>8</sup>

Unlike World War I through Vietnam, the Gulf War incidents of fratricide were fully documented. While there is still some argument as to the exact causes in each case, confidence in the numbers and types of the incidents is high. Of the total of 615 battle casualties in the war, 35 U.S. soldiers and Marines were killed and 72 were wounded in 28 friendly fire incidents.<sup>9</sup> The math works out to 23 percent of allied casualties in Desert Storm were from friendly fire. In addition, 77 percent of all combat vehicles lost (seven of ten Abrams tanks and 20 of 25 Bradley infantry fighting vehicles) were destroyed by friendly fire.<sup>10</sup>

While air-to-surface fratricide historically is the most common, only nine of the 28 Gulf War incidents, (resulting in 11 killed and 15 wounded) were of this type.<sup>11</sup> The incidents of surface-to-surface fratricide in the Gulf War was higher. Fifteen of the 28 friendly fire incidents, (resulting in 23 killed and 57 wounded) were in this category.<sup>12</sup> There was only a single incident in the surface-to-air category (resulting in no casualties) and there were no confirmed cases of air-to-air fratricide.

In summary, fratricide has and continues to be a painful reality of warfare. Compared to the other major U.S. conflicts of this century the Gulf War raises serious questions related to fratricide trends. While its unwise to draw too many conclusions from the numbers, it would be equally unwise to discount the significant increase in the percentage of casualties resulting from friendly fire.

## CHAPTER III

### IMPACT

The impact of fratricide is significant. The effects go beyond the obvious loss of life, weapon systems and material. While the friendly fire casualties in Desert Storm were small in relation to the total number of troops involved, their impact was anything but small. Certainly the media is playing an increasing role in magnifying the impact of fratricide. The public seems to have little tolerance of the 'fog of war' explanations following each incident. However, beyond the public relations aspects, the operational commander needs to be particularly attentive to the impact fratricide has on lowering morale and undermining confidence in supporting units. Both of these issues can directly affect the success of an operation.

Fratricide can rob an operation of its offensive mindset and shake the confidence of everyone from the CINC to the basic ground soldier. The impact on morale can raise the vulnerability to enemy fire due to increased restraint and caution following a fratricide. This effect was witnessed several times during the Gulf War and was summarized by the 2d Armored Cavalry Regiment commander's comment following a friendly fire incident of 27 February 1991:

" . . . People showed a lot of restraint. Everybody came a little bit closer to the enemy because they wanted to make sure."<sup>13</sup>

Further, some contend that several commander's overreaction to friendly fire unnecessarily put the troops at increased risk by imposing overly restrictive fire control procedures. One such commander instructed his unit not to engage the enemy - even if fired upon. A subordinate tank squadron commander allowed "it could have been disastrous."<sup>14</sup>

As mentioned, fratricide also has a chilling effect on confidence in supporting units. This impact goes deeper than just causing strained relations (not a small issue in the era of joint/coalition warfare). I contend of equal concern is the potential to reduce communication and coordination which, as will be discussed, can serve to increase the risk of future fratricide.

Linked to the loss of confidence in supporting units is the loss of faith in supporting weapons systems such as artillery or close air support (CAS). Illustrating this point was the reluctance of the troops in the 2d Armored Division to request Air Force A-10 CAS aircraft on Army AH-64 support following a fratricide incident which involved a AH-64 that mistakenly fired a 'Hellfire' missile into a Bradley.<sup>15</sup>

The bottom line is the cost of fratricide is high and given the future expectation of quick wars with few casualties the impact of each fratricide incident on the success of an operation is amplified.

## CHAPTER IV

### CAUSES AND CONTRIBUTING FACTORS

The causes of fratricide can be divided into two categories, mechanical and human.

A mechanical failure is, as the term implies, a fratricide that results from a weapon or system that does not perform as designed. An example of mechanical failure occurred when two soldiers were wounded when an AGM-88 High-Speed Anti-Radiation Missile fired by an F-4G "Wild Weasel" did not properly acquire its target, as designed, but rather locked on the soldiers' radar.<sup>16</sup>

The human causes of fratricide are much more varied and complex. Most cases of friendly fire are blamed to misidentification, and/or disorientation, but this is an oversimplification of the problem. There are numerous factors which historically contribute to the human causes including; inadequate command and control, poor communication, degraded battlefield visibility, nature of the terrain, poorly trained or unseasoned troops and confusion.<sup>17</sup>

Inadequate command and control includes the problems associated with poor operational planning, improperly designed fire control procedures and Rules of Engagement (ROE),

inability (or unwillingness) to impose fire control discipline and the design and execution of airspace control plans. Of course, related to command and control is poor communication. In every war failure to properly communicate and coordinate has proven costly.

The problem of degraded visibility includes weather factors, such as sand storms and darkness. Certainly the first step in identifying the enemy is being able to see them.

As in all combat, the nature of the terrain played a role in the Gulf War fratricide cases. The vast, featureless desert made it very difficult for both ground troops and airmen to maintain situational awareness.

Green troops are much more vulnerable to friendly fire. Understandably, fear, nervousness, excitement and fatigue can cause miscommunication, misunderstandings and general confusion in all troops, but especially in unseasoned ones.<sup>18</sup> Fog and friction are permanent fixtures of war.

I believe modern warfare has increased the list of contributing factors by at least three - technology, force composition and doctrine.

Technology has had a profound effect on the likelihood of friendly fire. The increased range of modern weapons in many cases exceeds the effective distance at which a target can be



positively identified. Also, the speed of the weapons and their delivery systems reduces, by a considerable margin, decision and reaction time.<sup>19</sup> Additionally, the increased accuracy and lethality of modern ordnance magnifies the seriousness of any mistakes. As summarized by General Charles Horner, the air component commander in the Gulf War, any hit on a friendly vehicle resulted in a "disaster" due to the dramatic improvement in precision-guided weapons.<sup>20</sup>

The composition of forces also plays heavily in increasing the fratricide risk. The increased complexity of joint and coalition warfare bring several problems into focus beyond the obvious cultural and communication issues.

Today sorting out friend from foe is considerably more difficult in light of technology and arms transfers. The ever increasing transfer of war materials from the industrial countries to the developing nations is creating a mixed bag of equipment and technology in the inventories of allies and potential adversaries.<sup>21</sup> This problem was especially true in the Gulf War. Commanders had to deal with U.S. tanks and combat vehicles fighting side-by-side with Syrian and Egyptian units using Soviet built tanks that resembled the equipment of the Iraqi forces.<sup>22</sup>

Finally, doctrine, the way we chose to fight, appears to be contributing to the increased risk of friendly fire.

"Modern American warfighting is now frontless and emphasizes night attacks with heavy doses of firepower, fast maneuvering, and deep penetration. . . . These highly fluid and fast moving operations require detailed coordination as friend and foe are tightly intermingled."<sup>23</sup>

In summary, the causes of fratricide are two - mechanical and human. The mechanical causes are simple, . . . the human causes, and the increasing list of contributing factors, are infinitely more complex. Ironically, several features of modern warfare which proved so effective in the Gulf War seem also to be on the list of factors increasing the risk of future friendly fire. Dr. Shrader believes:

"The limits of human ability to control such destructive forces have been approached . . . the gap between the capabilities of machines and the human ability to control them adequately is increasing."<sup>24</sup>

CHAPTER V  
WORKING THE PROBLEM

Technology.

There is the position that the basic explanation for fratricide is the failure of the military to come to grips with the technology issues.<sup>25</sup> Many believe that friendly fire is a technology based malady which can be 'cured' primarily with doses of technology, and this approach does hold some promise.

Several technology based solutions have been developed in recent years. These systems span the full low to high tech range. Most are devices which attempt to improve combat identification or are systems designed to increase battlefield situational awareness.

In the low-tech range are devices such as the VS-17 panels. During the Gulf War these florescent orange markings were placed on coalition vehicles as an aid to pilots in sorting out friendly forces.<sup>26</sup> Moving up the technology scale was the development of the Defense Advanced Research Project Agency (DARPA) Lights.<sup>27</sup> These infrared beacons are fixed atop friendly vehicles and are intended to assist identification in low visibility conditions and darkness. At the high end of technology solutions are the electronic identification friend

or foe (IFF) systems. IFF systems have been used on aircraft and air defense artillery weapon systems for decades. They allow for separation of friend from foe via electronic interrogation. The Army is currently researching the application of IFF technology for ground forces.<sup>28</sup>

In the area of improving combat situational awareness are devices designed to provide reliable navigation information. Most notable is the move to equip U.S. forces with Global Positioning Systems (GPS). The Army rushed more than 7,500 of these highly accurate satellite navigation devices to ground units deployed in the Gulf War.<sup>29</sup>

While anti-fratricide technologies including the devices mentioned, do provide a measure of protection, I contend a strategy which places too much hope in mechanical fixes is flawed. Clearly technology solutions do not adequately address the non-technical causes of fratricide. Even against the technically sensitive aspects of the problem, mechanical fixes fall short of the mark in the areas of performance, cost and vulnerability to enemy exploitation.

Put simply, the performance of the currently fielded anti-fratricide devices has not matched expectations. For example, the DARPA Lights rushed to the U.S. Army during the last days of the Gulf War were found to be of limited use because they

can only be seen through night vision goggles which A-10 pilots, providing CAS, couldn't use because of incompatible cockpit lighting.<sup>30</sup>

Anti-fratricide technology is also susceptible to cost problems. Most fratricide prevention efforts are after the fact, follow a war in periods of shrinking defense spending. These systems come into direct competition with more glamorous projects. Furthermore, the devices on the hi-tech end of the scale tend to be very expensive which further puts them at risk of cancellation. A case in point was the Mark 15 IFF system. The Mark 15 was the next generation of IFF system which had been in development for the last 10 years. Despite the dramatic technical improvements the system promised, and a 500 million dollar research effort, the program was killed recently based on the \$70,000 per copy price tag.<sup>31</sup> Loss of the mark 15 IFF leaves the U.S. and its NATO allies with the same IFF system it has used since the mid sixties.<sup>32</sup>

Development of anti-fratricide devices has also suffered due to concern over enemy exploitation. For example, experts now agree that GPS signals can potentially be disrupted, or worse modified with bogus information, unless aggressive action is taken to protect GPS data.<sup>33</sup>

Properly designed and supported, technology based solutions are effective. However, even at its best, technology doesn't cover the spectrum of friendly fire causes. As such technology can only be expected to play a supporting role in anti-fratricide efforts.

### Doctrine.

If in fact the characteristics of modern warfare are increasing the fratricide risk, then doctrine must be considered vital in any program to manage the problem. The Gulf War greatly increased the momentum of changes in doctrine related to fratricide prevention.

Doctrine is the tool that can help the operational commander walk the fine line between own capability and vulnerability to the enemy as he plans and directs the operation toward the strategic objective. The principles of war demand boldness and audacity -- seemingly counter to the protective caution necessary to prevent fratricide. Helping in this dilemma, doctrine assists the commander by providing proven risk management tools and guidance.

Doctrine is particularly important in development of fratricide awareness, incorporating fratricide prevention in operational planning, design of peacetime training programs and

even in overcoming the weaknesses in joint acquisition of anti-fratricide technology.<sup>34</sup> Also flowing from doctrine are the principles for the development of command and control organizations and responsibilities. One example is the Joint Force Air Component Commander's (JFACC) role in integrating airspace control at the operational level. Additional doctrinal control measures include airspace coordination areas (ACAs), restrictive fire lines (RFLS) and fire coordination lines (FLLS).<sup>35</sup>

Witness to the influence of doctrine on fratricide prevention was its role in avoiding ground-to-air and air-to-air friendly fire during the Gulf War. The JFACC's command and control, as expressed in the planning and execution of the air campaign, was especially effective given the number and variety of aircraft and air defense systems involved not to mention the cultural and language diversity.

While doctrine plays a fundamental role in the fratricide prevention effort, it like technology, is only part of the solution. Furthermore, there are several unresolved doctrinal issues which have significant fratricide implications. Most notably is the contest between the services for the deep battle -- what defines it and who controls it.

## **Training.**

Addressing the human causes of fratricide, in addition to assessing the effectiveness of anti-fratricide doctrine and technology, is the role of training. Perhaps the greatest legacy of the Gulf War is the focus it placed on the importance of rigorous, realistic training as a means of reducing friendly fire. Training is especially important in developing fire discipline, exercising planning and coordination functions and building confidence in supporting units and weapon systems.

An excellent example of the fratricide avoidance benefits of training is in the CAS mission area. Realizing the friendly fire potential in the Gulf War, coalition air and ground forces took part in an unprecedented in-theater training program in the months prior to the shooting. In fact, fifty-seven percent of all A-10 sorties were flown before hostilities began.<sup>36</sup> Due in large part to this effort, there was only a single case of close air support fratricide.

In preparation for the next war no service has taken a more aggressive approach to fratricide prevention training than the Army. Following up on an extensive study of Gulf War lessons learned the Army has expanded anti-fratricide training in the majority of its mission simulation and leader development programs. These programs are vigorous and



comprehensive. An example is the training conducted at the National Training Center (NTC). Anti-fratricide training techniques now include introduction of mixing lost and friendly flank units into unit sectors, technology capable of collecting friendly fire data and through 'no-holds-barred' debriefing procedures which maximize lessons learned.<sup>37</sup>

Reflecting doctrine, the training is increasingly joint. In fact, the Air Force has strengthened its training program by ensuring that half of the CAS missions each year are flown with the Army at the NTC.<sup>38</sup> This joint training trend should continue to grow.

Correctly, the services know it is unwise to expect a five month in-theater 'spin-up' for the next war. Understanding the importance of training in the fratricide prevention effort the services have, thus far, maintained a proactive attitude in developing and funding realistic programs. However, the training momentum has not extended to our potential coalition partners. General Hoar, Commander-in-Chief, U.S. Central Command sees a disturbing trend in the reduced international training and education programs offered to potential coalition partners in his Area of Responsibility.<sup>39</sup> If we, in fact, anticipate heavy reliance on coalitions warfare in the future, then the U.S. must press the lesson that training is the only

way to bridge the gap between anti-fratricide technology and doctrine.

## CHAPTER VI

### CONCLUSIONS

Because war is conducted by humans, and Murphy's law being what it is, fratricide will never be completely eliminated. In fact there is every reason to believe that modern warfare has increased the risk of friendly fire. The losses to fratricide during the Gulf War brought the issue into sharp focus and the services have worked the problem hard. But, as the recent tragic shoot down of the two American Blackhawks over northern Iraq indicates, much remains to be done.

The temptation is to look mostly for technological answers. Anti-fratricide devices can be of significant value and research and development should continue. Indeed, the loss of momentum in programs such as the Mark 15 IFF is a serious blow to fratricide avoidance. However, technology is only part of the fratricide prevention effort. Technology solutions do not adequately address the human dimensions of the problem. Doctrine and training must also be considered. It stands to reason that even the best equipment in the hands of poorly trained troops will not reduce the fratricide risk. Of course key to guiding the technology and training programs is doctrine. The challenge is to reduce the losses due to

friendly fire without reducing combat effectiveness. Only a combined application of anti-fratricide doctrine, training and technology is likely to produce the desired result.

## NOTES

1. Bruce Van Voorst, "They Didn't Have To Die," Time, 26 August 1991, p.20.

2. Ibid.

3. Charles R. Shrader, "Amicicide: The Problems of Friendly Fire in Modern War," Combat Studies Institute Research Survey No.1, (Fort Leavenworth: December 1982), p.viii.

4. Department of the Army FM 100-5, Operations, (Washington, DC, U.S. Government Printing Office, 1993), p.2-11.

5. Shrader, p.105.

6. Ibid., p.106.

7. Ibid.

8. Ibid., p.105.

9. "Military Probes Friendly Fire Incidents," DOD News Release, Office of the Assistant Secretary of Defense, Public Affairs, August 13, 1991, pp.1-2.

10. Ibid.

11. Ibid.

12. Ibid.

13. Julie Bird, "Friendly Fire," Army Times, 19 August 1991.

14. Ibid., p.11.

15. Ibid.

16. Rick Maze, "Study: Better Systems Would Cut Fratricide," Air Force Times, 26 July 1993, p.30.

NOTES (CONT'D)

17. Charles R. Shrader, "Friendly Fire: The Inevitable Price," Parameters, Autumn 1992, p.38.

18. David H. Hackworth, "Friendly Fire Casualties," Marine Corps Gazette, March 1992, p.46.

19. Shrader, "Friendly Fire: The Inevitable Price," p.39.

20. Casey Anderson, "Horner Underscores Tragedy of Friendly Fire," Air Force Times, 3 June 1991, p.24.

21. Paul M. Ziegler, "Considerations for the Development of Theater Hostilities Rules of Engagement: Blue-on-Blue Versus Capability Sacrifice," Unpublished Research Paper, U.S. Navy War College, Newport, RI, 1992, p.3.

22. Stewart M. Powell, "Friendly Fire," Air Force Magazine, December 1991, p.61.

23. Hackworth, p.46.

24. Shrader, "Amicicide, The Problem of Friendly Fire in Modern War," p.109.

25. Michael P. O'Connor, "Fratricide: A Preventable Technological Disease," Unpublished Research Paper, U.S. Army War College, Carlisle Barracks, PA, 1992, p.21.

26. Ibid., p.15.

27. Ibid., p.16.

28. Ibid., p.17.

29. U.S. Department of the Army, "Information Paper: Position Navigation (Global Positioning) System," (Colorado Springs: U.S. Army Space Command, 30 August 1991), p.7.

30. Julie Bird, "JCS Push for Vehicle ID's Is Called Political," Air Force Times, 9 September 1991, p.25.

NOTES (CONT'D)

31. Steve Watkins, "Aircraft Systems Haven't Improved," Air Force Times, 2 May 1994, p.14.

32. Ibid.

33. Ibid.

34. William B. Garrett, "Fratricide: Doctrine's Role in Reducing Friendly Fire," Unpublished Research Paper, U.S. Army Command and General Staff College, Fort Leavenworth, KS, 1992, p.38.

35. Ibid., p.39.

36. Powell, p.62.

37. Dwight B. Duckson, "Avoiding Not So Friendly Fire," Military Review, July 1992, p.62.

38. Ibid.

39. Joseph H. Hoar, "An Address," Lecture, U.S. Naval War College, Newport, RI: 4 May 1994.

## BIBLIOGRAPHY

- Anderson, Casey, "Horner Underscores Tragedy of Friendly Fire," Air Force Times, 3 June 1991.
- Bird, Julie, "Friendly Fire," Army Times, 19 August 1991.
- Bird, Julie, "JCS Push for Vehicle ID's Is Called Political," Air Force Times, 9 September 1991.
- Bryan, C.D.B. Friendly Fire. New York: G.P. Putnam's Sons, 1976.
- Duckson, Dwight B., "Avoiding Not So Friendly Fire," Military Review, July 1992.
- Department of the Army FM 100-5, Operations, (Washington, DC, U.S. Government Printing Office, 1993).
- DOD News Release, "Military Probes Friendly Fire Incidents," Office of the Assistant Secretary of Defense, Public Affairs, August 13, 1991.
- Garrett, William B., "Fratricide: Doctrine's Role in Reducing Friendly Fire," Unpublished Research Paper, U.S. Army Command and General Staff College, Fort Leavenworth, KS, 1992.
- Hackworth, David H., "Friendly Fire Casualties," Marine Corps Gazette, March 1992.
- Hoar, Joseph H., "An Address," Lecture, U.S. Naval War College, Newport, RI: 4 May 1994.
- Interview With Colonel William Hatch, Commander, AH-64 Battalion in Desert Storm, 27 April 1994.
- Maze, Rick, "Study: Better Systems Would Cut Fratricide," Air Force Times, 26 July 1993.
- O'Connor, Michael P., "Fratricide: A Preventable Technological Disease," Unpublished Research Paper, U.S. Army War College, Carlisle Barracks, PA, 1992.



### BIBLIOGRAPHY (CONT')

Powell, Stewart M., "Friendly Fire," Air Force Magazine, December 1991.

Shrader, Charles R., "Amicicide: The Problems of Friendly Fire in Modern War," Combat Studies Institute Research Survey No.1, (Fort Leavenworth: December 1982).

Shrader, Charles R., "Friendly Fire: The Inevitable Price," Parameters, Autumn 1992.

U.S. Department of the Army, "Information Paper: Position Navigation (Global Positioning) System," (Colorado Springs: U.S. Army Space Command, 30 August 1991).

Van Voorst, Bruce, "They Didn't Have To Die," Time, 26 August 1991.

Watkins, Steve, "Aircraft Systems Haven't Improved," Air Force Times, 2 May 1994.

Ziegler, Paul M., "Considerations for the Development of Theater Hostilities Rules of Engagement: Blue-on-Blue Versus Capability Sacrifice," Unpublished Research Paper, U.S. Navy War College, Newport, RI, 1992.